English Translation

JP2002-50459

[11] Unexamined Japanese Patent Publication No. 2002-50459
(P2002-50459A)

[43] Date of Publication: February 15, 2002

[51] Int. Cl.[7]: H05B 3/34, F24D 13/02, H05B 3/03 3/10 3/14 3/20

[54] Title of the Invention: Planar Heating Unit and Heating Apparatus Using the Same

[21] Application Number: 2000-235434 (P2000-235434)

[22] Date of Filing: August 3, 2000

[71] Applicant: Matsushita Electric Industrial Co., Ltd.
1006 Oaza-Kadoma, Kadoma-City, Osaka, Japan

[72] Inventors: Shintaro Nozawa, Mitsuru Yoneyama, Naohito Asami, Norio Abe, Akihiro Maeda, Kazumi Nagayama, (Kadoma, Osaka, Japan)

[57] Abstract

[Object] To supply an optimum voltage to a heating element and obtain a desired heating temperature by uniformly and stably forming electrodes and the heating element of conductive materials.

[Means to Solve the Problem] A heating unit comprises substrate 1 made of a flexible woven fabric, electrodes 3a and 3b of an electrically conductive material on the surface of substrate 1, and heating element 4 having a self-temperature regulating function and connected with electrodes 3a and 3b, wherein substrate 1 is provided with permeation preventive treatment layer 2 on at least a portion thereof.

[What is claimed is]

[Claim 1] A planar heating unit comprising a substrate having flexibility, an electrode disposed on a surface of the substrate, and a heating element

having a self-temperature regulating function and connected with the electrode, wherein the substrate is provided with a permeation preventive treatment layer on at least a portion thereof.

[Claim 2] The planar heating unit as set forth in claim 1, wherein the permeation preventive treatment layer is formed on at least a portion of each of the both surfaces of the substrate.

[Claim 3] The planar heating unit as set forth in one of claim 1 and claim 2, wherein the permeation preventive treatment layer is formed by coating an impermeable material.

[Claim 4] The planar heating unit as set forth in one of claim 1 and claim 2, wherein the permeation preventive treatment layer is formed by depositing a layer of an impermeable material.

[Claim 5] The planar heating unit as set forth in one of claim 1 and claim 2, wherein the permeation preventive treatment layer is formed by thermally melting the surface of the substrate.

[Claim 6] The planar heating unit as set forth in one of claim 1 through claim 5, wherein the permeation preventive treatment layer has an electrically insulating property.

[Claim 7] The planar heating unit as set forth in one of claim 1 through claim 6 further comprising any of an electrical insulation layer and a protective layer on the electrode and the heating element.

[Claim 8] The planar heating unit as set forth in claim 7, wherein at least one of the electrical insulation layer and the protective layer is provided with an anti-static property.

[Claim 9] The planar heating unit as set forth in one of claim 3 through claim 5, wherein the impermeable material is provided with an anti-static property.

[Claim 10] The planar heating unit as set forth in one of claim 1 through claim 9, wherein the substrate is provided with an anti-static property.

[Claim 11] The planar heating unit as set forth in one of claim 1 through claim 10, wherein at least one of the electrode and the heating element is mixed with a material having flexibility.

[Claim 12] The planar heating unit as set forth in claim 11, wherein the material having flexibility comprises any of an urethane resin and a polyester resin.

[Claim 13] A heating apparatus provided with the planar heating unit as set forth in one of claim 1 through claim 12.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to a planar heating unit used for a planar heating/warming apparatus having a self-temperature regulating function such as a floor heater, an electrically-heated carpet, a tatami-mat heater, an automobile seat heater and the like, and also a planar heating unit used for a water heater, a rice cooker and the like.

[0002]

[Background Art] A planar heating unit of the prior art, for example, comprises substrate 101, a pair of electrodes 103a and 103b having electrical conductivity formed on substrate 101, and heating element 104 having a self-temperature regulating function and connected with the pair of electrodes 103a and 103b, as shown in Fig. 6. Reference mark 105 is a power supply. Reference mark 106 denotes a connector, for which a rivet and an eyelet terminal or the like member are used. Reference mark 107 denotes a connecting wire, for which a lead wire or the like conductor is used. An

electric current is supplied from power supply 105 to electrodes 103a and 103b through connecting wires 107a and 107b, and connectors 106a and 106b. Fig. 7 is a cross sectional view of the planar heating unit taken along the line P - P shown in Fig. 6. As shown in Fig. 7, an electric potential provided between electrodes 103a and 103b causes an electric current I to flow, and generates heat in heating element 104. Heating element 104 provided with the self-temperature regulating function has such a characteristic that a temperature of the heating element rises when it is energized, but its resistance increases rapidly when it reaches a given temperature, thereby regulating its own temperature.

[0003]

[Problems to be Solved by the Invention] It was a common practice in the planar heating unit of the prior art that electrodes composed of conductive films and a heating element having the self-temperature regulating function are formed on an un-impregnated substrate such as a PET film with printable materials in the form of ink. In the case of planar heating unit for a floor heater, electrically-heated carpet, tatami-mat heater, automobile seat heater and the like, however, the heating unit itself is required to be flexible. For this reason, the conventional planar heating unit was not usable if it has a substrate made of a PET film and the like material. In general, woven fabric is often used as the substrate requiring flexibility. However, there was a problem of causing variations in thickness of conductive films when woven fabric was used as the substrate, since such materials in the form of ink, when printed, permeate into lattice-like meshes in the knitted fibers of the substrate or even into the fibers themselves. As a result, there occurred such problems that the electrodes produce abnormal over-heating due to increase of resistance in certain areas where the films became partially thinner, and an

excessive voltage drop due to the large resistance in these areas that prevent the electric current from flowing smoothly toward the distal ends of the electrodes. These problems hence obstructed the heating element from being impressed with the proper voltage, thereby resulting in a failure of the heating element to provide the satisfiable temperature performance. There was also a problem that the heating element does not produce uniform distribution of temperature due to inability of heating to the desired temperature when there are variations in the film thickness.

[0004]

[Means to Solve the Problems] To solve the above problems, a heating unit of the present invention comprises a substrate having flexibility, an electrode disposed on one surface of the substrate, and a heating element having a self-temperature regulating function and connected with the electrode, wherein the substrate is provided with a permeation preventive treatment layer on at least a portion thereof.

[0005] According to the above invention, the electrode made of an electrically conductive material and the heating element having the self-temperature regulating function can be formed into a wiring pattern of excellent configuration without irregularity on the substrate provided with permeation preventive treatment, by means of a printing method using the conductive materials in paste form as printing inks. In other words, conductor films composing the electrode and the heating element can be formed with so small a variation in the thickness as possible, since the substrate is not permeable.

[0006] Since the electrode and the heating element are formed on permeation preventive treatment layer provided on the flexible substrate, this device is adaptable for use in any such product as an electrically-heated carpet and an automobile sheet heater that can be bent easily.

[0007]

[Description of the Preferred Embodiments] A planar heating unit of the present invention comprises a substrate having flexibility, an electrode disposed on one surface of the substrate, and a heating element having a self-temperature regulating function and connected with the electrode, wherein the substrate is provided with a permeation preventive treatment layer on at least a portion thereof.

[0008] Since the substrate is provided with the permeation preventive treatment layer, the electrode and the heating element having the self-temperature regulating function made of the conductive films can be formed uniformly into the wiring pattern without variations in their thicknesses by means of the printing method using the conductive materials of paste form as the printing inks.

[0009] In addition, the permeation preventive treatment layer is formed on at least a portion of the both surfaces of the substrate.

[0010] The permeation preventive treatment layer is provided additionally with one or more properties of impermeability, electrical insulation, resistance to abrasion, resistance to contamination, resistance to weather and incombustibility, to achieve these features. Also, since the electrode and the heating element can be formed by printing the ink on both surfaces of the substrate, there is provided the planar heating unit capable of heating the both surfaces or only one surface to regulate the temperature by way of controlling the electric currents to these surfaces alternately.

[0011] The permeation preventive treatment layer is provided by coating an impermeable material on the surfaces of the substrate.

[0012] In a process of coating impermeable material, the impermeable material is dissolved in a solvent and sprayed to adhere it to the substrate of

woven fibers, which is then dried. This process enables the impermeable material to seep into lattice-like meshes of the fibers or inside of the fibers, to easily complete the permeation preventive treatment. Furthermore, the process helps the impermeable material to interweave with the woven fibers, improves the adhesion, and makes it not easily separable.

[0013] The permeation preventive treatment layer may be provided by depositing the impermeable material into a layer on the surface of the substrate.

[0014] The process of depositing the impermeable material into a layer form can produce a uniform thickness of the impermeable material and omit the step of drying solvent in the manufacturing process, thereby improving the manufacturing efficiency.

[0015] Moreover, the permeation preventive treatment layer may be formed by thermally melting the surfaces of the substrate.

[0016] The process of melting the surfaces of the substrate by using a hot roller or the like means make mass-production possible with stable quality.

[0017] Furthermore, there is provided additionally with an electrical insulation layer over the electrode and the heating element.

[0018] This structure can provide a superior property of the electrical insulation for the electrode and the heating element.

[0019] Any of the impermeable material and the substrate may additionally be provided with an anti-static property.

[0020] The anti-static property can prevent static electricity generated by friction when the automobile seat heater, electric carpet or the like is used.

[0021] The electrode and the heating element are also mixed with a material having flexibility.

[0022] This makes the electrode and the heating element capable of

following flexion of the substrate without being damaged even if the substrate is made of woven fiber and the like having an extensible property.

[0023]

[Exemplary Embodiment] Description is provided of an exemplary embodiment of the present invention with reference to the accompanying drawings.

[0024] Embodiment 1: Fig. 1 is a cross sectional view depicting a structure of a planar heating unit according to embodiment 1 of this invention. Fig. 2 is an external view depicting the structure of the planar heating unit according to embodiment 1. In Fig. 1, reference mark 1 denotes a substrate having flexibility as it is composed of woven fibers. Substrate 1 is provided with permeation preventive treatment layer 2 on at least a portion of it. A pair of electrodes 3a and 3b in a shape of conductive film are formed on permeation preventive treatment layer 2 with a conductive material of printable form by such means as screen printing. The conductive material used for the electrodes includes silver paste and copper paste. There is also heating element 4 having a self-temperature regulating function composed in a manner so that it is electrically connected with portions of the pair of electrodes 3a and 3b. Heating element 4 having the self-temperature regulating function used here is a PTC heater composed of a resin material mixed with conductive particles such as carbon to form the heating body, and it has a characteristic of increasing the electric resistance responsive to temperature rise. The PTC heater is formed into a plane shape with flexibility by means of the screen printing method in the like manner as the electrodes. The power to electrodes 3a and 3b is supplied from power supply 5 such as a battery, as shown in Fig. 2. Electrodes 3a and 3b and power supply 5 are connected via connectors 6a and 6b comprised of rivets and eyelet

terminals, and connecting wires 7a and 7b such as lead wires. A voltage is thus impressed between electrodes 3a and 3b. By providing permeation preventive treatment layer 2 in this manner on the surface of substrate 1, the ink does not permeate into lattice-like meshes in the knitted fibers or into the fibers themselves even when the substrate is formed of a fibrous material like woven fabrics, thereby avoiding variations in thicknesses of the conductive films. As a result, the conductive films can be made into uniform thickness when formed by the printing method.

[0025] The embodied heating unit having the above structure operates in a manner which is described hereinafter. As shown in Fig. 1, heating element 4 having the self-temperature regulating function is connected electrically to electrodes 3a and 3b. When power supply 5 impresses a positive potential on electrode 3a and a negative potential on electrode 3b, an electric current I flows from electrode 3a toward electrode 3b through heating element 4 to generate heat in heating element 4.

[0026] The property of electrical insulation is required for the surface on which electrodes 3a, 3b and heating element 4 are printed, and this is achieved by mixing an electrical insulating material into the permeation preventive treatment layer, or by using a substrate with insulating property.

[0027] In the above embodiment, the power supply was shown as to be the DC power source. However, the like advantageous effect can be attained with an AC power supply when the heating element is made of a material having a self-temperature regulating characteristic suitable for the AC power supply, as needless to mention.

[0028] Here, the printing method with a drying process was employed using the ink containing conductive material to form the wiring pattern of the electrodes and the heating element. However, the conductive material may

be mixed with an UV hardening agent as an alternative method. Furthermore, the conductive material may be in a pulverized form, so that the wiring pattern can be formed with an electrostatic coating process, as another alternative method.

[0029] Materials suitable as the substrate with flexibility include clothes woven with the warp and weft, pile fabrics such as velveteen, corduroy, towel and the like pile velvet, general fabrics such as plain fabric, rib-stitched fabric, purl-stitched fabric, tucked fabric, brocade, piled fabric, lace fabric, single-Denbigh fabric, single-vandyked fabric, double-Denbigh fabric and single-vandyked fabric, unwoven fabric made of a base cloth willowed with cotton by needle-punching, artificial leather, synthetic leather, rubber, and so forth.

[0030] Materials thought to be suitable as the impermeable material include polyester resin, urethane resin, fluorine resin and the like. The substrate is laminated or impregnated with any of these materials in a manner to fill meshes in the knitted fibers or to seep into the fibers. An improvement of the heating efficiency can also be achieved by providing the impermeable material with a thermal insulation property.

[0031] The permeation preventive treatment needs not be made on the entire surface of the substrate, but it can be a part of the surface so long as it covers an area where the wiring pattern of the electrodes and the heating element is formed. A required amount of the impermeable material can be thus reduced to cut cost of the material.

[0032] Fig. 3 shows a concrete example of such treatment. Fig. 3 includes a plan view (Fig. 3 (a)) and a cross sectional view (Fig. 3 (b)) of a planar heating unit of this invention adapted for use in an automobile seat heater.

[0033] As shown in Fig. 3, the planar heating unit is so constructed that

permeation preventive treatment layer 2 is disposed on a part of substrate 1, and electrodes 3a, 3b, and heating element 4 are formed on this permeation preventive treatment layer 2. Substrate 1 is also provided with a plurality of hanging tabs 15 in a manner to extend from the periphery thereof for the purpose of mounting this unit to a seat of an automobile. In this instance, hanging tabs 15 keep the original flexibility of the substrate since they are not treated with the impermeable material. This structure can hence avoid a problem of workability in the process of hanging work, and prevent a user sitting into the seat from feeling stiffness due to the hanging tabs if hardened by the permeation prevention treatment. The area provided with the permeation preventive treatment layer can be restricted in this manner depending on the function needed for the individual heating apparatus in which this planar heating unit is used.

[0034] There are other examples of substrates having their surfaces treated with lamination of impermeable materials, such as those of unwoven fabrics bonded with PET films and the like, and those laminated with polymeric resin materials such as PP, PE and the like.

[0035] There are also examples of substrates having their surfaces thermally melted to form the permeation preventive treatment layers. These substrates are made of such materials as polyester and acrylic resins, of which surfaces are heated while being compressed to make the substrates melted and flattened into smooth surfaces.

[0036] The permeation preventive treatment layer is provided with an electrical insulation property to ensure that the electrodes and the heating element maintain their normal state of electrical operation without causing a short circuit.

[0037] Moreover, any of the impermeable material and the substrate may be

treated with an anti-static agent to provide the anti-static property. This can be achieved by such a method as application of a surface active agent directly to the surfaces of the substrate or the surface active agent mixed with the impermeable material when applying it to the surfaces of the woven fibers to reduce a coefficient of friction and hence suppressing the static electricity. Or, electrical conductivities of the electrodes and the heating element may be improved by decreasing their electrical resistances.

[0038] In addition, the electrodes and the heating element may be covered with any of an electrical insulation layer and protective layer made of a polyester, PET or the like film. Provision of the layer can prevent the electrodes of different polarities from short-circuiting, improve resistance to abrasion, impermeability and bonding strength of the electrodes and the heating element, so as to protect them from the external stresses and environment.

[0039] The electrodes and the heating element may be mixed with a material having flexibility to make them capable of following flexion of the substrate without being damaged even if the substrate is made of woven fiber having extensibility.

[0040] It is conceivable that the planar heating units of this invention can be used for electric heating/warming apparatuses represented, for example, by an electrically heated carpet shown in Fig. 4, as one of the alternative applications. Reference mark 8 denotes a heating surface provided internally with heating element 4. Reference mark 9 denotes a control unit for controlling heating element 4 with the capability of adjusting it to the desired temperature. Reference mark 10 denotes a power supply cord for supplying power from an AC power supply. By virtue of the above structure, the user is able to sit on heating surface 8 to get warm. The planar heating

units are also adaptable for use in warmers like the one shown in Fig. 5. Reference mark 11 denotes a heating element for heating object 12 to be kept warm. Reference mark 13 denotes an outer enclosure, which confines object 12 to maintain thermal insulation while protecting it from the external environment. Reference mark 14 denotes a power supply cord for supplying power from an AC power supply. The warmer can keep the object warm by virtue of the above structure. Other specific products for which these planar heating units are adaptable include such heating/warming apparatuses and warmers as electrically-heated lap robe, electric blanket, electrically-heated foot warmer, floor heater, tatami-mat heater, electrically-heated mattress, electrically-heated cushion, heated bathroom mat, heated jacket, heated gloves, heated toilet seat with cover, automobile seat heater, to name a few.

[0041]

[Advantage of the Invention] According to the planar heating unit of the present invention, as described above, the electrodes and the heating element can be formed stably into thin films by printing or the like method while controlling variations in the thickness of the conductive materials as small as possible, since the substrate of flexible woven fabric is provided with the permeation preventive treatment layer by the printing method. The invention can thus provide the planar heating units adaptable for use in planar heating apparatuses such as floor heaters, electrically-heated carpets, tatami-mat heaters, automobile seat heaters, and warmers used in water heaters, rice cookers and the like. In addition, since the invention can compose the electrodes and the heating element of uniform film thickness with small variations, there is not any increase locally in the resistances of the electrodes leading to abnormal over-heating. The electrodes hence allow the electric current to flow smoothly toward their distal ends to produce

uniform distribution of the temperature.

[Brief Description of the Drawings]

[Fig. 1] A cross sectional view showing a planar heating unit according to exemplary embodiment 1 of the present invention.

[Fig. 2] An external view showing the planar heating unit according to the exemplary embodiment 1 of the present invention.

[Fig. 3] Structural drawings showing another planar heating unit wherein a permeation preventive treatment layer is provided over a part of a substrate according to the exemplary embodiment 1 of the present invention.

[Fig. 4] An external view showing an electric heating/ warming apparatus as an example of product equipped with the planar heating unit of this invention.

[Fig. 5] An external view showing an electric warmer as another example of product equipped with the planar heating unit of this invention.

[Fig. 6] An external view showing a structure of a planar heating unit of the prior art.

[Fig. 7] A cross sectional view showing the structure of the planar heating unit of the prior art.

[Description of the Reference Marks]

1 Substrate

2 Permeation preventive treatment layer

3a, 3b Electrode

4 Heating element